

Energetic Materials Synthesis

Novel nitro- and amino-substituted heterocyclic compounds

LNL has an ongoing program dedicated to the R&D of energetic materials. The program includes design and synthesis of new compounds, scale-up of their synthesis, and performance and sensitivity testing for evaluation in DOE and DOD applications. These capabilities were recently demonstrated in the synthesis, scale-up, and characterization of the new energetic materials CL-20, 2-oxo-1,3,5-trinitro-1,3,5-triazacyclohexane (K-6), and HNX, and in our scale-up of the synthesis of 2,4-dinitroimidazole (DNI).

APPLICATIONS

- New insensitive high explosives
- Conversion of surplus stockpile explosives into useful products
- Energetic polymer ingredients, radiolabeled compounds, and gas generators
- Synthesis and scale-up of pharmaceutical and agricultural chemicals

Our synthesis group works closely with our formulation group to develop new methods for making energetic formulations with improved safety and performance. We have identified two new compounds, 6-nitro-2,4-toluenediisocyanate (NTDI) and LLM-101, that will be used by the formulation group to develop energetic block copolymers.

Our focus

In response to a growing concern for enhanced safety and pollution reduction, our current focus is on (1) the synthesis of new insensitive energetic materials that outperform 1,3,5-triamino-2,4,6-trinitrobenzene (TATB) but have similar sensitivity and stability characteristics, and (2) the demilitarization of explosives to higher-value products.

New insensitive high explosives

We have synthesized several insensitive heterocyclic compounds whose performance is similar to that of TATB. These compounds were designed to possess many of the properties that

contribute to the “enhanced insensitivity” of TATB (i.e., a planar structure with a high degree of hydrogen bonding). We have synthesized small, heterocyclic compounds possessing both amino- and nitro-substituents. Our extensive experience in synthesizing heterocyclic compounds may be applied in the future to the synthesis and scale-up of pharmaceutical and agricultural chemicals.

Demilitarization of explosives

The demilitarization of stockpile explosives is currently a major concern to the DOE and DOD. We are investigating the conversion of the surplus explosives, such as TNT and ammonium picrate (Explosive D), to higher-value products. We are investigating their conversion to chelating resins, TATB, organic aerogels, starburst polymers, and 6-nitrotoluene-2,4-diisocyanate (NTDI), an energetic polymer ingredient.

DOD projects

We have begun to scale-up the synthesis of DNI to the 5- to 10-lb level at our Site 300 pilot plant. The material will be used in formulation of hard-structure munitions and for evaluation as an insensitive energetic material. This project is being carried out in conjunction with DOD sponsors at the Navy and Air Force.

Availability: Available now. We invite collaboration with industrial partners who can work with us to develop a commercially viable product.

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